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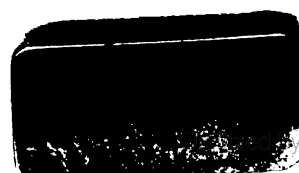
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AN INVESTIGATION AND DEVELOPMENT
OF A WATER POWER PROJECT ON
THE FLAMBEAU RIVER NEAR
LADYSMITH, WIS.

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LADYSMITH, WIS.

BY

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AND

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A THESIS SUBMITTED FOR THE DEGREE OF
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-I--N--D--E--X-

Location	Page
Flambeau River	1
Drainage Area	1
Maximum and minimum discharge	1
Rainfall	3
Storage	5
Power hydrograph	6
Design	7
Study of Flood Conditions	7
Design of Tainter Gate Section	8
Layout of Dam	9
Design of Dam	10
High Head Section	10
Weir Section	10
Estimate	11
Quantities	11
Cost	17
Turbine and Generator Selection	18
Selection of the number of units	18
Analysis of Smith-McCormick wheel	20
Analysis of Allis-Chalmers wheel	21
Comparison of wheels	21
Appendix "A" - Monthly rainfall data,	23
"B" - Daily rainfall data	29
"C" - Flood flow data	35

LOCATION

The proposed hydro-electric development considered in this report is to be constructed at Big Falls on the Flambeau River in Rusk County, Wisconsin, near the village of Ladysmith. The site is in the northwestern part of the state near the juncture of the Flambeau and Chippewa rivers. No towns of appreciable size are situated in this vicinity, the closest town of over 10,000 population being Ashland, Wis., which is about 90 miles north of the proposed site.

FLAMBEAU RIVER

Drainage Area

The drainage area of the Flambeau River lies in the northern part of Wisconsin within the glaciated area, which contains many small lakes and watercourses. The river flows southwest into the Chippewa River, the juncture being in the southern part of Rusk County. This area includes 2120 sq. mi. with an extreme length of 81 miles, and an average width of 27 miles. A map of the drainage area is shown in Plate I.

Maximum and Minimum Discharge of the Flambeau River:

The data upon which the discharge of the Flambeau River was determined was taken at Ladysmith, Wis., by the United States Geological Survey. The gauging station was established in 1903 and was discontinued in 1906 giving complete readings for four years. The data was taken from "Progress of Stream Measurements" for the above years. This data gave the gauge

height at the station or point of observation, in feet. A rating table accompanying the observations gave the discharge in cubic feet per second corresponding to the different heights of the gauge. These discharges expressed in cubic feet per second were reduced to cubic feet per square mile of drainage area by dividing by the size of the drainage area or 2120 sq. mi. It was found by a study of this data that the year 1904 was the year of minimum discharge and 1906 that of maximum discharge for the years for which such data was available.

For these maximum and minimum years of 1906 and 1904 hydrographs were plotted. These hydrographs are curves on which the horizontal scale represents time subdivided into months and from this scale any day in the year can be located. The vertical scale represents the flow as computed in cubic feet per second per square mile of drainage area for each day of the year. Therefore, from these hydrographs the flow of the river for any day of the year in question can be determined by reading the discharge as plotted and multiplying the flow so determined by the number of square miles of drainage area above the station. These curves also show the variation of the discharge for any period of time. These curves are shown on Plates II and III.

For the minimum year of 1904, a duration curve was plotted. This curve shows for the given year the number of days on which a given discharge was noted. This curve was plotted to the same horizontal and vertical scales as the hydrographs, and is shown in Plate II. For example: if one cubic foot per second per

square mile of drainage area is required, the curve shows the number of days on which this or a larger discharge took place. Therefore, the curve shows the duration of any given flow.

Rainfall

The primary source of stream flow is, of course, the rainfall^a and direct relation exists between the two, but there is no direct proportion which this relation follows; however, a careful examination of rainfall records together with the stream flow data tends to establish this proportion for the particular drainage area in question. Therefore, a study of the rainfall records will give a general understanding of the the flow of the Flambeau River when examined in connection with the hydrographs, and will give an indication of the relation of rainfall to run-off to be expected in the future.

The monthly rainfall was figured for the following government stations on or near the drainage area:

Ashland	Prentice
Barron	Medford
Butternut	Weyerhauser,
Hayward	Appollonia
Ladysmith	

The average for each month for all these stations was taken from 1889 to 1913 as far as the government data was complete. This data is included in Appendix A. The results were plotted using inches of rainfall as the vertical scale and months as the horizontal scale. These curves show the average monthly rainfall over the entire drainage area, and are shown in Plates IV to VII inclusive.

The daily rainfall for the same stations on the drainage area was figured and was successively added giving the cumulative rainfall to date for each day of the minimum year. This data is shown in Appendix B. Then with the day of the year as the horizontal scale and inches of rainfall as the vertical scale, the daily cumulative rainfall was plotted, and is shown in Plate VIII. This curve shows for any given date the total amount of rainfall during the year up to that day.

From the hydrograph shown in Plate II, the daily discharge of the river in cubic feet per second per square mile was taken. Knowing the size of the drainage area, this was reduced to depth of discharge in inches over the drainage area. These amounts were successively added giving a cumulative discharge in inches. This curve was plotted to the same co-ordinates or scales as the cumulative rainfall curve, and is shown on the same Plate.

The daily cumulative rainfall curve shows the amount of rain that fell on the drainage area. The cumulative discharge curve shows the amount of water that was discharged from the river. Therefore, the difference in amount of these two curves represents the amount of rainfall that fell on the drainage area but was not discharged by the river; hence it was retained on the drainage area either in the soil or by vegetation, or else it was lost by evaporation. These differences were figured and plotted on the same co-ordinates on Plate VIII, as shown by the dotted curve. This gives a cumulative retention

curve showing directly the difference in amounts between rainfall and runoff for the given period of time.

Storage

Due to the topography of the Flambeau River above the dam site, it is found possible to construct a dam so as to impound a considerable amount of water. The quantity of water which can be impounded depends of course upon the height of the dam and the depth to which the water is drawn during periods when the stored water is needed to augment the natural river flow. As the water is lowered, the head will be reduced, which fact has been considered in all power calculations.

From a study of the map of the pondage area which is shown in Plate IX, it is seen that the dam may be readily built up to elevation 1275, which, as the elevation of the river is 1195, gives a maximum head of 80 feet. It was decided to make the minimum head 60 feet, thus operating between the limits of elevation 1275 and elevation 1255, or 60 to 80 foot heads. This gives an amount of storage water that may be drawn off to augment low flow equal to the volume of water between elevation 1255 and 1275. This volume of pondage was found by planimetry of the pondage area and multiplying by the depth. The volume so determined was found to be 1,427,250,000 cu. ft.

Having obtained the amount of pondage, it is necessary to find the number of horsepower hours which this volume of water will develop. The average head or fall of this pondage water will be 75 feet. Therefore, the horsepower hours due

$$\text{to pondage} = \frac{1,427,250,000 \text{ cu. ft.} \times 75 \text{ ft.} \times 62.5}{33,000 \times 60}$$

$$= 3,380,000 \text{ H.P. Hours.}$$

Power Hydrograph

The hydrograph for the minimum year of 1904 has also been prepared to show the actual horsepower corresponding to the actual stream flow. The basis of this calculation is the power delivered by turbines of 80% efficiency under a head of 80 feet. The power scale is placed at the right of this hydrograph and measures the available daily power in horsepower hours. (See Plate II).

The method of determining the amount of horse power that may be developed is as follows: the horizontal dotted lines on the power hydrograph represent various horse powers. Wherever the hydrograph lies above the given horse power line, there is enough water to develop this power, but where the hydrograph lies below the line, there is not enough water flowing in the river to develop that amount of horse power. This deficiency must be made up by the storage which was found to be 3,380,000 horse power hours. Now by measuring the area lying between the given horse power line and that part of the hydrograph lying below the horse power line, the number of horse power hours necessary to make up the deficiency is found. Thus, for any particular power, the amount of storage necessary to develop this power can be found. This was done for various powers as follows:

To develop 8,000 H. P.

Required H. P. hours of pondage . . . 3,510,000

H. P. Hrs. of pondage available . . . 3,380,000

To develop 7,000 H.P.

Required H. P. hours of pondage . . . 2,880,000

H. P. hours of pondage available . . 3,380,000

To develop 6,000 H. P.

Required H. P. hours of pondage . . . 2,440,000

H. P. hours of pondage available . . 3,380,000

From the above calculations a development of 7,000 H. P. was decided on. This amount of power can be developed continuously without an auxiliary steam plant. By constructing the power hydrograph for 1904, these figures are based on the lowest year for which data is available.

DESIGN

Study of Flood Conditions

One of the most important factors in dam design is that the spillway or tainter gate section shall be of sufficient capacity. This means that this overflow section must be designed for the maximum flood. In order to make a determination of this maximum flood, a study of flood water conditions in the past on the Flambeau River as well as adjacent rivers is necessary. This study extended over observations taken for a period of seven years, from 1903 to 1910 inclusive. The flood conditions of six rivers were observed, namely, the

Flambeau, Chippewa, Black, Wolf, Wisconsin, and Menominee. Knowing the maximum discharge for a given year on a certain river, as obtained from the government data, and knowing the drainage area of the river above the point at which this discharge obtained, it was possible to calculate the maximum flood flow in second feet per square mile of drainage area. This was done for each river for the given years. (For data see Appendix C.) The maximum flood flow occurring on any river for any year was that on the Black in 1905, when a flow of 17.5 sec. ft. per square mile was obtained. The maximum flood flow noted on the Flambeau was in 1906, which gave a flow of 5.2 sec. ft. per square mile. After a study of this data it was decided to design the tainter gate section for a flood flow of 10 sec. ft. per square mile. Although a flow of over 17 sec. ft. was noted on the Black, it is certain that like conditions could never obtain on the Flambeau as the small size and topography of the drainage area, which includes many small lakes and tributaries acting as natural reservoirs, limits the flood flow, and it is hardly possible that a greater flow than 10 sec. ft., which is twice as great as any previously noted, could ever occur.

Design of Tainter Gates:

Assuming a flood flow of ten second feet, the total discharge will be 10×2120 (drainage area) = 21,200 sec. ft. A certain part of this flow goes through the turbines that are delivering power, which amount depends on the head. Under

flood conditions the head will be about 65 feet, and the amount of power being developed will be at least 4000 H. P., or with 80% efficiency at turbines, the discharge will correspond to a power of 5000 H. P. Thus the discharge will be

$$\frac{5,000 \times 550}{60 \times 62.5} = 735 \text{ sec. ft.}$$

The amount of water that will have to pass through the tainter gate section will then be 21,200 - 735 or 20465 second feet.

Under flood conditions the velocity of the water passing the tainter gates was figured to be 10 feet per second. Therefore to pass a flood of 20465 second feet, a cross section equivalent to $\frac{20465}{10}$ or about 2050 sq. ft. is necessary. The tainter gates are to be ten feet in depth. Thus the length of the tainter gate section must be $\frac{2050}{10}$ or 205 feet. It was decided to use fifteen 14' x 10' gates, which gives a length of 210 feet.

Layout of Dam

A large topographical map of the dam site was plotted up on which the layout was made. The tainter gate section as designed was laid out in the middle of the stream, with the power house on the east bank and the log and fish way to the left of the tainter gates. (See Plate X). The dam proper will consist of a high head concrete gravity section the top of which will be at elevation 1280. At each end of this section two earthen embankments with concrete core walls join on to the gravity section by means of concrete wing walls.

The cross section (Plate XI) shows the elevation of the different sections and the elevation and slope of the ground and bed rock surfaces.

Design of Dam - High Head Section

The high head section was designed according to Wegmann's method of determining the theoretical profile. This method consists in determining at successive horizontal sections beginning at the top the necessary size of section to fulfill conditions of stability. By this method, taking sections sufficiently close, the profile may be determined with any desired degree of exactness. Sections 20' deep were taken in this case, and a top width of 15' assumed.

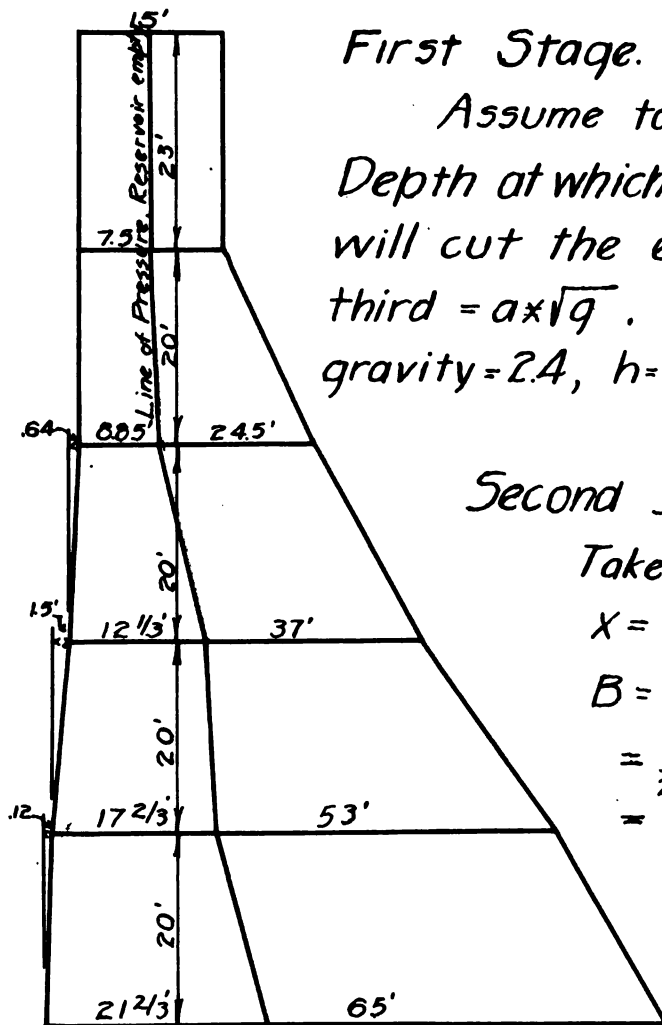
After the theoretical profile is calculated, a practical profile is fitted over it. For this practical profile see Plate XIII. The calculations for this theoretical profile are given on pages 10-a and 10-b.

Design of Weir Section

The overflow section under the tainter gates requires a little special design as a crest of ten feet passes over it and it has a ten foot smaller head. For this overflow weir an Ogee section was determined upon. The object of this form is to guide the water smoothly over the dam, and to deliver it at the bottom tangentially with the stream bed. The convex curve to be given to a dam should be full enough to prevent the water from leaving the surface. Such a curve is a parabola whose equation is $y = \frac{g}{2v^2}x^2$. (Taken from Turneure &

10-A

CALCULATION OF THEORETICAL PROFILE.



First Stage.

Assume top width to be 15'.
Depth at which resultant pressure will cut the edge of the middle third = $a \times \sqrt{q}$. $a = 15'$, $q = \text{specific gravity} = 2.4$, $h = 15\sqrt{2.4} = 23.9$. Use 23'

Second Stage.

Take 20' Sections.

$$X = \sqrt{B + C^2} - C$$

$$B = \frac{d^3}{qh} + \frac{6AM}{h} + L^2$$

$$= \frac{43^3}{2.4 \times 20} + \frac{6 \times 23 \times 15 \times 7.5}{20} + 15^2$$

$$= 1670 + 725 + 225 = 2670$$

$$C = \frac{1}{2} \left(\frac{4A}{h} + L \right)$$

$$= \frac{1}{2} \left(\frac{4 \times 23 \times 15}{20} + 15 \right) = 42$$

$$X = \sqrt{2670 + 42^2} - 42 = 24.5$$

$$n = \frac{(\overline{24.5}^2 + 15 \times 24.5 + 15^2) \frac{20}{6} + 23 \times 15 \times 7.5}{15 \times 23 + \frac{15 \times 24.5}{2} \times 20} = 8.85$$

$n > X/3 \therefore \text{O.K.}$

Third Stage.

$$X = \sqrt{\frac{d^3}{qh} + \left(\frac{L}{2} + \frac{A}{n} \right)^2} - \left(\frac{L}{2} + \frac{A}{n} \right)$$

$$= \sqrt{\frac{63^3}{2.4 \times 20} + \left(\frac{24.5}{2} + \frac{740}{20} \right)^2} - \left(\frac{24.5}{2} + \frac{740}{20} \right)$$

$$= \sqrt{5000 + 2425} - 49.25 = 37.0'$$

$$y = \frac{2A(x - 3m) - hL^2}{6A + h(2L + X)}$$

$$= \frac{2 \times 740(37 - 3 \times 8.85) - 20 \times 24.5^2}{6 \times 740 + 20(2 \times 24.5 + 37)} = \frac{3900}{6160} = .635$$

Fourth Stage.

$$x = \sqrt{\frac{83^2}{24 \times 20} + \left(\frac{37}{2} + \frac{1354}{20}\right)^2} - \frac{37}{2} + \frac{1354}{20}$$

$$= \sqrt{11900 + 7400} - 86 = 53'$$

$$y = \frac{2 \times 1354(53 - 3 \times 12.33) - 20 \times 37^2}{6 \times 1354 + 20(2 \times 37 + 53)}$$

$$= \frac{2708 \times 16 - 27,400}{8120 + 2540} = \frac{15900}{10,660} = 1.5'$$

Fifth Stage.

$$x = \sqrt{\frac{103^2}{24 \times 20} + \left(\frac{53}{2} + \frac{2254}{20}\right)^2} - \left(\frac{53}{2} + \frac{2254}{20}\right)$$

$$= \sqrt{22,600 + 19,300} - 139 = 65'$$

$$y = \frac{2 \times 2254(65 - 3 \times 17.66) - 20 \times 53^2}{6 \times 2254 + 20(2 \times 53 + 65)}$$

$$= \frac{4508 \times 12 - 5600}{13,524 + 3420} = \frac{2000}{16,944} = .12'$$

Russell's Public Water Supply.) This curve was calculated and plotted as shown in Plate XII. Knowing this curve, it was figured that a base of 65 ft. was ample to give stability to the dam under the given conditions. This base is further extended by a concrete apron which is provided to take care of the scouring effect. This increases the length of the base to a total of 100 ft. For the details of this section as well as that of the earth section and cross section of the piers see Plate XIII.

ESTIMATE

From the cross section of the layout (Plate XI) and the different dam sections (Plate XIII) the amounts of excavation and also the amounts of concrete and earth embankment were estimated. A detailed estimate of these quantities follows:

Excavation

1. East Core Wall, width 2'

STATION	:	DEPTH	:	AREA	:	AV. AREA	:	VOLUME CU.YDS.
0	:	14	:	28	:	28	:	104
1	:	14	:	28	:	27	:	100
2	:	13	:	26	:	25.5	:	94.5
3	:	12.5	:	25	:	25.5	:	94.5
4	:	13.0	:	26	:	26	:	48
4+50	:	13	:	26	:		:	
T o t a l - - - -								441 cu.yds.

2. East Wing Walls.

20' long x 3' wide at base x $-\frac{13+13}{2}-$ (aver.depth)

= 780 cu. ft.

Two walls = $-\frac{2 \times 780}{27}-$ = 58 cu. yds.

3. High Head Section

STATION	:	AREA	:	AVER. AREA	:	VOLUME
4 + 50	:	240	:	253	:	445
5	:	266	:	309	:	1145
6	:	352	:	397	:	1470
7	:	442	:	436	:	1610
8	:	429	:	440	:	1630
9	:	450	:	410	:	1520
10	:	371	:	388	:	935
10+65	:	405	:		:	
13+60	:	235	:	232	:	515
14	:	228	:	339	:	1255
15	:	450	:	455	:	1685
16	:	460	:	415	:	1540
17	:	370	:	362	:	1340
18	:	354	:	357	:	1325
19	:	360	:	360	:	1365
20	:	378	:	336	:	1245
21	:	294	:	294	:	1090
22	:	294	:	287	:	1025
23	:	280	:	257	:	950
24	:	234	:	213	:	586
24 + 75	:	192	:		:	
T o t a l 22676 cu.yds.						

4. West Wing Walls.

$$2/27 (20 \times 3 \times \frac{11}{2} \frac{12}{2}) = 51 \text{ cu.yds.}$$

5. West Core Wall

STATION	:	DEPTH	:	AREA	:	AV. AREA	:	VOLUME
24 + 75	:	12	:	24	:		:	
25	:	11	:	22	:	23	:	21
26	:	11	:	22	:	22	:	82
27	:	10	:	20	:	21	:	78
28	:	12	:	24	:	22	:	82
29	:	11	:	22	:	23	:	85
30	:	9	:	18	:	20	:	74
31	:	8	:	16	:	17	:	63
T o t a l 485 cu. yds.								

6. Excavation through Spillway 100' wide.

STATION	:	DEPTH	:	AREA	:	AV. AREA	:	VOLUME
10 + 65	:	7	:	700	:	550	:	712
11	:	4	:	400	:	425	:	1570
12	:	4.5	:	450	:	475	:	1760
13	:	5	:	500	:	450	:	1665
13 + 60	:	4	:	400	:		:	
T o t a l								5707 cu.yds.

7. Power House

$$1/27 \times 125' \times 45' \times \frac{13 + 29}{2} = 4380 \text{ cu. yds.}$$

TOTALS.

1.	East Core Wall	441 cu.yds.
	West Core Wall	485
	East Wing Wall	58
	West Wing Wall	51
	High Head Section.	22676
	Spillway excavation.	5707
	Power House.	4380

33,798 cu.yds.

25%	Rock Excavation	8450 cu.yds.
75%	Earth Excavation	25350 cu.yds.

AMOUNT OF EARTH EMBANKMENT

STATION	:	AREA	:	AV. AREA	:	VOLUME
0	:	00	:		:	
1	:	80	:	40	:	148
2	:	200	:	140	:	520
3	:	440	:	320	:	1185
4	:	760	:	600	:	2220
4 + 50	:	1000	:	880	:	1630
	:		:		:	
24 + 75	:	1000	:	900	:	835
25	:	800	:	660	:	2440
26	:	520	:	460	:	1700
27	:	400	:	250	:	925
28	:	100	:	75	:	278
29	:	50	:	38	:	140
30	:	25	:	12	:	45
31	:	0	:		:	
T o t a l						12066 cu.yds.

AMOUNT OF CONCRETE

1. Core Walls - 2' wide

STATION	:	DEPTH	:	AV. DEPTH	:	VOLUME
1 + 25	:	12	:		:	
2	:	16	:	14	:	78
3	:	19	:	17.5	:	130
4	:	22	:	20.5	:	152
4 + 50	:	26	:	24	:	89
	:		:		:	
24 + 75	:	25	:	24.5	:	45
25	:	24	:	22	:	163
26	:	20	:	18	:	133
27	:	16	:	14.5	:	107
28	:	13	:	12	:	44
28 + 50	:	11	:		:	
T o t a l . .						941 cu. yds.

2. High Head Section.

STATION	AREA	AVER. AREA	VOLUME
4 + 50	471		
5	520	495	917
6	660	590	2180
7	820	740	2740
8	1020	920	3410
9	1580	1200	4800
10	2300	1990	7360
10 + 65	3100	2700	6500
13 + 60	3020		
14	2860	2940	4350
15	2260	2560	9500
16	1380	1920	7100
17	1220	1300	4810
18	960	1090	4040
19	900	930	3440
20	780	840	3110
21	720	750	2780
22	600	660	2440
23	580	590	2190
24	500	540	2000
24 + 75	460	480	1330
T o t a l			74997 cu.yds.

3. Wing Walls

$$20 \times 2.5 \times 30 = 1500$$

$$4 @ \frac{1500}{27} = 222 \text{ cu.yds.}$$

4. Tainter Gate Section

Note: Bottom of section laid on level excavation. Therefore same length and section over all.

Area of section = 3400 sq. ft.

$$\text{Vol.} = \frac{3400 \times 210}{27} = 26,400 \text{ cu.yds.}$$

5. Piers.

18 piers, average depth 103', 4' wide.

$$\text{Vol. of 1 pier} = 4 \times 4480 - \frac{5 \times 4}{2} \times 103 = 18930 \text{ cu.ft.}$$

$$\text{Vol. of 18 piers} = \frac{18 \times 18930}{27} = 12,600 \text{ cu.yds.}$$

6. Operating Platform

$$\text{Area of Section} = 3 \times 1 + 1 \times 1 = 4 \text{ sq. ft.}$$

$$\text{Volume} = \frac{4 \times 210}{27} = 31 \text{ cu.yds.}$$

TOTALS

High Head Section	74,997 cu.yds.
Core walls ,	941
Wing Walls,	222
Weir Section	26,400
Piers	12,600
Operating Platform.	31

	115,191 cu.yds.

COST ESTIMATE

FROM a study of amounts, local conditions with regard to current prices, and such cost data as was available, the following cost estimate was made up.

Concrete

High head section, 74997 cu.yds. @ \$6.00 . . .	\$ 449,982.
Core Walls, 941 " @ 8.00 . . .	7,528.
Wing Walls, 222 " @ 8.00 . . .	1,776.
Weir Section, 26400 " @ 8.00 . . .	211,200.
Piers, 12600 " @ 8.00 . . .	100,800.
Operating Platform, 31 " @ 13.00 . . .	403.

Earth Embankment

12,066 cu.yds. @ \$.40 4,825.

Excavation

Earth, 25,350 cu.yds. @ \$.35 8,860.

Rock, 8,450 cu.yds. @ \$1.50 ,. 12,700.
Rock

Timber Trestle - For log and fishway.

$M = L(240 + 9 H) = 350(240 + 9 \times 55) = 242,000$

242 M At \$80.00 per M 19,360.

Power House

$120 \times 50 \times 45 = 270,000$ cu.ft. @ \$.16 43,200.

Grand Total \$ 860,634.

TURBINE AND GENERATOR SELECTION

Selection of the Number of Units

The design of this plant calls for a development of 7000 H. P. or approximately 5200 kilowatts. It was decided to install four 1200 K. W. generators which would give a total of 4800 K. W. or very near the maximum available power, providing all were operated continuously. However, until a market is built up, not more than three quarters of this amount of power will be sold, or about 3600 K. W. This permits of one generator to be used for a reserve unit.

In all turbines the quantity of discharge, the speed, the power, the efficiency and the head on the wheel are closely related and vary in accordance with certain definite laws modified by the design of the turbine and the conditions under which it is to operate. In any particular case, the conditions are fairly well fixed, and the problem of turbine selection becomes one of finding some standard wheel which will best fit the given conditions. In this case where the turbines are direct connected to the generators, the generators must run at a given constant speed which necessitates the selection of a turbine that will give that speed. For the service for which the generators are to be put, a 60 cycle machine will be used and a 1200 K. W. unit has been decided upon. Knowing these two conditions, the factor which will affect the operating speed of the generator will be the number of pairs of field poles. Following is a table of the speeds of a 1200 K. W. 60 cycle generator for various numbers of poles:

For 18 pairs of poles - - - - Speed 200 R. P. M.

17	208
16	225
15	240
14	257
13	276
12	300
11	327
10	360
9	400
8	450
7	514
6	600

Knowing these speeds at which operation may take place, it is necessary to find some wheel whose economical speed will correspond at least closely with one of these values, and then farther test that wheel out for its efficiency at the desired power output.

The power required for each unit is 1200 K. W., or 1600 H. P. There will be two runners on each shaft, so that two wheels will be furnishing power to one generator, therefore the required power from each wheel will be 800 H. P. Now knowing the average head at which the wheel will operate, and the required power, the economical speed of the wheel may be found by substituting in the formula, $K_5 = n^2 P/h^{5/2}$ in which n is the speed, P the power, h the head, and K_5 a constant which

is known for certain types or series of wheels. By this formula the economical speed of a number of wheels were figured, having given their values of K_5 .

<u>Make of Wheel</u>	<u>Economical Speed R.P.M.</u>
Sampson	482
Improved Sampson	565
Smith-McCormick	415
Smith	625
Standard Trump	480
Allis-Chalmers Type F	566
Allis-Chalmers #1883	445
Wellman-Seaver-Morgan Co.	538
James Leffel & Co. #1924,	552
James Leffel & Co., #1899	525

Comparing this table with the allowable generator speeds, it may be seen that there are only two wheels that closely fit an allowable speed. These are the Smith-McCormick to run at 400 R. P. M., and the Allis-Chalmers #1883 to run at 450 R. P. M. These two wheels were analyzed.

Analysis of the Smith-McCormick wheel

From the formula $P = K_2 D^2 h^{3/2}$, where D is the diameter of the wheel and K_2 is a known constant, the diameter of the desired wheel to operate under the given conditions was found to be 25 inches. Then from a test on a Smith-McCormick wheel the efficiency, discharge, and horsepower curves were plotted. (See Plate XIV). These curves are plotted against ϕ , which is

the constant ratio of the peripheral velocity of the wheel to the spouting velocity of the water, and they show the actual efficiency developed, the power developed, and the amount of discharge for the wheel in question between the operating heads of 60 and 80 feet. Having given these curves, the horsepower efficiency curve may be plotted (See Plate XIV) which shows for the two limiting heads the efficiency of the wheel at whatever amount of power it is developing. This curve furnishes the basis for the actual selection of the wheel.

Analysis of the Allis-Chalmers Co. #1883 wheel

Following the same analysis, the diameter of the proposed wheel was computed to be 26". In the case of this wheel a test was obtained from which the efficiency, horse power, and discharge curves had already been plotted. By means of these curves the efficiency horsepower curve was plotted directly, and placed on the same set of co-ordinates with the efficiency horsepower curve of the Smith-McCormick wheel for the purpose of comparison.

Comparison of the Wheels

In the Smith-McCormick wheel, the 80' head gives a lower efficiency than the 60' head. Also the maximum efficiency of this wheel comes at a power of about 600 H. P., and by the time it has reached 800, the desired horsepower, the efficiency drops to 81%. The other wheel fits the conditions much better as at an 80' head and delivering a power of 800 H. P., the

ordinary conditions of operation, it has an efficiency of 87%. Under both heads and for practically all conditions, the Allis Chalmers wheel has higher efficiencies than the Smith-McCormick.

From the results of this analysis, the installation will consist of eight 26" Allis-Chalmers Type E, (#1883) turbines, two on a shaft, direct-connected to four 1200 K. W., 60cycle 16 pole generators.

MONTHLY RAINFALL IN INCHES FOR VARIOUS STATIONS

Legend: Medford - - Station No. 1
 Butternut - " No. 2
 Hayward - - " No. 3
 Ashland - - " No. 4
 Barron - - " No. 5
 Appolonia - " No. 6
 Prentice- - " No. 7
 Ladysmith - " No. 8
 Weyerhauser " No. 9

YEAR 1889

STAS.	JAN.	FEB.	MAR.	APR.	MAY.	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
1	:	:	:	:	:	:	3.40	2.83	2.78	.05	1.70	2.18
2	:	:	:	:	:	:	:	:	:	.38	2.73	1.73
Aver:	:	:	:	:	:	:	3.40	2.83	2.78	.21	2.21	1.95

YEAR 1890

1	1.19	1.56	1.76	1.70	4.38	4.50	3.43	6.17	7.87	3.68	.80	.80
2	1.02	5.42	:	1.58	3.73	3.77	6.46	5.76	4.75	3.12	.94	.39
3	:	:	:	:	:	:	3.45	:	2.56	.91	.28	
AVER:	1.10	3.49	1.76	1.64	4.06	4.14	4.95	5.13	6.31	3.12	.88	.49

YEAR 1891

1	2.13	2.33	2.23	2.72	.46	3.99	1.75	2.63	2.78	3.65	.48	5.06
2	1.11	1.73	2.05	1.57	.70	2.64	:	2.53	1.71	2.40	:	
3	.85	2.28	2.42	1.46	2.15	1.91	3.33	1.81	1.93	2.16	.80	3.35
4	1.13	2.23	2.11	2.14	1.34	4.57	1.51	3.26	2.86	2.72	1.68	2.81
5	:	:	:	:	:	2.68	1.86	1.42	1.46	1.90	.70	.52
AVER:	1.31	2.14	2.18	1.97	1.16	3.20	2.11	2.33	2.15	2.57	.91	2.94

YEAR 1892

1	1.35	1.57	1.10	2.03	6.60	9.50	4.85	2.03	1.91	2.38	1.25	.50
2	.30	2.30	1.30	.30	2.15	:	:	:	:	:	:	.56
3	.51	1.71	1.43	3.10	4.00	:	:	:	:	:	:	
4	1.24	1.49	1.87	2.90	4.96	2.41	3.03	4.01	.45	1.32	1.54	.44
5	.26	1.73	.98	2.29	7.03	7.44	4.61	3.94	1.77	1.80	1.04	.71
AVER:	.73	1.76	1.33	2.12	5.19	6.45	4.16	3.33	1.38	1.83	1.28	.55

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1905.

YEAR 1893

STAS:	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
1	: .76:	2.25:	1.65:	3.45:	3.46:	1.98:	2.80:	1.57:	2.14:	3.00:	.90:	2.65
2	: .44:	1.34:	1.67:	2.52:	3.88:		5.14:	5.01:	2.37:	3.77:	.70:	2.26
3	: 1.00:	3.00:	2.37:	2.05:	2.50:	1.25:	6.50:	4.12:	2.24:	3.20:	.65:	1.73
4	: 1.23:	4.10:	2.51:	2.76:	2.22:	2.68:	3.72:	1.32:	1.45:	3.20:	1.49:	1.93
5	: 1.23:	2.91:	1.75:	4.91:	3.85:	1.25:	3.28:	3.66:	2.85:	3.40:		2.05
AVER.	: .93:	2.72:	1.99:	3.14:	3.18:	1.79:	4.29:	3.14:	2.21:	3.32:	.94:	2.12

YEAR 1894

1	: 1.10:	1.30:	1.95:	4.07:	4.66:	2.59:	.93:	1.75:	2.86:	3.14:	1.58:	1.00
2	: .77:	.27:	3.23:								.90:	.84
3	: 1.30:	.30:	1.90:	1.70:	4.59:	1.14:	.56:	.72:	1.66:	3.78:	1.29:	.71
4	: 1.28:	1.03:	5.09:	3.80:	6.45:	2.90:	1.30:	1.82:	2.27:	4.98:	1.20:	.20
5	: 1.68:	.45:	2.44:	4.66:	8.94:	2.01:	2.40:	1.30:	1.85:	4.73:	1.40:	1.24
AVER.	: 1.23:	.67:	2.92:	3.55:	6.16:	2.16:	1.30:	1.37:	2.16:	1.66:	1.27:	.80

YEAR 1895

1	: 1.47:	.35:	.34:	1.05:	6.08:	4.93:	3.86:	3.19:	3.32:	.52:	1.84:	1.28
2	: 1.37:	.63:	.30:	.38:	6.15:	5.38:	4.31:		10.0:	2.1	.28:	2.03
3	: .92:	.33:	.54:	.83:	4.52:	7.74:	2.75:	5.19:	6.5:	.26:	.82:	.95
4	: 2.30:	.00:	.11:	.15:								1.40
5	: .83:	.60:	.48:	1.68:	3.03:	4.87:	4.93:	1.78:	3.90:	.26:	.80:	1.66
6	: 1.35:	.10:	.53:	1.53:	3.90:	4.36:	4.95:	1.52:	4.99:	.36:	.73:	1.04
AVER.	: 1.37:	.34:	.38:	.94:	4.74:	5.46:	4.16:	2.94:	5.78:	.38:	.89:	1.39

YEAR 1896

1	: 2.50:	.78:	.95:	2.61:	5.22:	4.10:	6.15:	3.18:	2.33:	2.45:	3.06:	.59
2	: 1.54:	.49:	1.70:	3.18:	4.04:		9.45:					
3	: 2.40:	.51:	1.95:	7.06:	5.10:	3.21:	1.40:	1.57:	2.03:	2.70:	1.51:	2.44
4	: .70:	.65:	.75:	4.30:	3.62:	1.75:	1.71:	1.00:	1.27:	3.64:	3.22:	1.20
6	: 1.00:	.20:	2.04:	5.38:	5.70:	4.35:	2.96:	3.94:	2.18:	3.82:	6.74:	.90
AVER.	: 1.63:	.53:	1.48:	4.51:	4.74:	3.35:	4.34:	2.42:	1.95:	2.85:	3.93:	1.28

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...

YEAR 1897

25.

STAS: JAN.: FEB.: MAR.: APR.: MAY : JUNE: JULY: AUG.: SEPT: OCT.: NOV.: DEC.

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1 :1.02: .66:2.15:1.34:1.45:8.12:5.27:2.59:1.90:2.45: .04: .40
2 :1.35: .88:1.56:      :      :6.54:15.1:1.31:2.38:2.01:1.25:
3 :1.94:2.28:3.39: .31:2.34:5.81:5.00:4.30:3.00:3.06:1.34: .41
4 :2.00: .80:1.60:1.05:2.07:4.41:8.21:3.39:2.86:1.67:1.06:1.20
5 :2.03:1.75:2.60:1.86:2.07:6.23:5.54:1.25:2.93:1.85: .29: .30
6 :1.60:1.40:3.35:      :      :      :      :      :      :      :
AVER:1.64:1.29:2.46:1.14:2.01:6.22:7.83:2.57:2.61:2.21: .79: .58

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YEAR 1898

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1 : .02:1.70:2.20:1.65:1.18:6.85:2.25:2.30:1.95:5.50:2.45: 0.0
2 : .77:1.93:1.46: .83:1.27:      :      :      :      :      : .25:
3 : .47: .98:2.65: .56:5.07:7.18:1.40:2.60:1.23:5.19:1.60: .06
4 : .80:1.80: .30: .40:2.50:1.90: .55:2.20:1.60:3.40:1.40:1.75
5 : .25:1.83:1.80:1.02:4.40:2.27:1.90:2.51: .98:4.64:1.00:0.00
7 :      :      :      :      :4.30:4.97:2.20:1.66:1.79:4.27:2.43: .11
AVER: .46:1.65:1.68: .89:3.12:4.63:1.66:2.25:1.51:4.60:1.54: .64

```

YEAR 1899

```

1 : .80: .80:1.75:1.58:6.40:5.90: .75:3.80:2.80:4.50: .40:2.50
2 : .77:1.93:1.46: .83:1.27:      :      :      :      :      : .25
3 :1.15: .89:2.44:1.48:4.84:4.60:1.78:4.46:2.61:6.53:1.50:1.25
4 :1.55:1.20:1.40:2.20:2.70:4.37:3.18:4.42:3.10:3.40: .30:2.30
5 : .45:1.16:3.30:1.73:3.15:6.70:2.00:5.87: .65:4.26: .95:2.02
7 : .81:1.01:1.73:2.57:7.17:7.75:3.07:7.40:3.47:5.56:1.13:1.50
AVER: .92:1.17:2.01:1.73:4.25:5.92:2.15:5.19:2.53:4.85: .85:1.46:

```

YEAR 1900

```

1 : .85:1.10: .90:2.95:2.50:1.35:8.78:6.40:7.95:10.8: .65: .75
2 : .40:1.30:1.05: .96: .91:1.16:6.55:8.86:8.07:6.02:1.77:1.17
3 :1.53:1.50:1.66:2.45: .32:2.1 :8.95:8.36:7.93:5.57: .71: .92
4 :1.80:1.00: .48:2.50: .76:1.37:5.71:4.80:4.40:2.91:1.22: .84
5 :1.16:      :1.19:1.11:1.71:2.20:7.70:7.64:      :5.40:1.00:1.05
7 :      :      : .79:3.46:1.55:3.03:13.4:7.28:      :      :
AVER:1.15:1.22: .97:2.24:1.29:1.87:8.51:7.22:7.09:6.13:1.07: .95

```

1. The first part of the document discusses the importance of maintaining accurate records of all transactions. It emphasizes that proper record-keeping is essential for the integrity of the financial system and for the ability to detect and prevent fraud. The document also notes that accurate records are necessary for the preparation of financial statements and for the calculation of taxes.

2. The second part of the document discusses the importance of maintaining accurate records of all transactions. It emphasizes that proper record-keeping is essential for the integrity of the financial system and for the ability to detect and prevent fraud. The document also notes that accurate records are necessary for the preparation of financial statements and for the calculation of taxes.

3. The third part of the document discusses the importance of maintaining accurate records of all transactions. It emphasizes that proper record-keeping is essential for the integrity of the financial system and for the ability to detect and prevent fraud. The document also notes that accurate records are necessary for the preparation of financial statements and for the calculation of taxes.

4. The fourth part of the document discusses the importance of maintaining accurate records of all transactions. It emphasizes that proper record-keeping is essential for the integrity of the financial system and for the ability to detect and prevent fraud. The document also notes that accurate records are necessary for the preparation of financial statements and for the calculation of taxes.

YEAR 1901

26.

STAS: JAN.: FEB.: MAR.: APR.: MAY JUNE: JULY: AUG.: SEPT: OCT.: NOV.: DEC.

1.	:	.35:	.35:	1.75:	.45:	3.00:	6.65:	4.75:	1.80:	5.95:	2.80:	.70:	.50
2	:	.72:	.50:	2.30:	1.45:	1.42:	5.03:	5.41:	5.29:	3.37:	1.90:	.60:	.72
3	:	.94:	.48:	2.15:	1.85:	1.07:	5.38:	4.00:	4.40:	5.47:	1.33:	.57:	.53
4	:	.37:	.39:	2.81:	1.36:	2.00:	8.68:	6.44:	2.33:	3.37:	2.00:	1.42:	.64
5	:	.49:	.50:	3.50:	2.22:	1.82:	5.23:	5.10:	1.70:	6.55:	1.28:	1.50:	.40
7	:	:	:	:	.90:	1.31:	5.50:	6.14:	2.80:	3.71:	2.28:	.22:	1.20
8	:	:	:	:	1.28:	.48:	5.10:	1.21:	1.07:	4.40:	1.10:	:	1.20
	:	:	:	:	:	:	:	:	:	:	:	:	:
AVER:	:	.57:	.44:	2.50:	1.36:	1.60:	5.94:	4.72:	2.77:	4.69:	1.81:	.83:	.74

YEAR 1902

1	:	1.00:	1.60:	1.70:	3.90:	5.30:	2.80:	7.20:	5.20:	4.15:	3.20:	5.30:	.70
2	:	.91:	1.65:	2.09:	2.78:	1.44:	3.37:	3.06:	1.74:	3.93:	3.06:	2.98:	1.51
3	:	1.01:	.22:	.40:	2.18:	1.28:	5.13:	5.36:	1.96:	3.96:	2.40:	2.42:	2.33
4	:	.81:	1.39:	.45:	2.23:	1.66:	2.79:	4.82:	1.99:	4.10:	1.55:	2.69:	1.76
5	:	1.50:	.26:	.86:	2.06:	3.63:	4.39:	3.65:	1.09:	2.39:	.68:	4.30:	1.37
7	:	1.50:	2.20:	.73:	2.46:	2.45:	6.11:	4.74:	2.85:	4.41:	3.01:	4.77:	2.80
8	:	1.95:	.83:	1.55:	2.17:	1.96:	3.20:	6.37:	3.03:	2.17:	2.61:	4.17:	2.36
	:	:	:	:	:	:	:	:	:	:	:	:	:
AVER:	:	1.17:	1.16:	1.11:	2.54:	2.53:	3.95:	5.03:	2.55:	3.59:	2.36:	3.80:	1.83

YEAR 1903

1	:	.20:	.20:	2.35:	3.95:	8.25:	.90:	7.40:	7.30:	9.50:	4.70:	.90:	.50
2	:	.75:	1.64:	3.27:	3.61:	8.88:	1.58:	9.88:	4.56:	6.98:	3.00:	1.26:	1.27
3	:	.38:	1.22:	.92:	1.49:	6.18:	1.78:	5.88:	5.06:	6.35:	4.95:	1.48:	1.05
4	:	.41:	1.91:	1.98:	2.03:	6.77:	.93:	6.55:	5.39:	5.22:	3.29:	.80:	1.11
5	:	.59:	.40:	2.52:	2.44:	5.86:	3.04:	6.55:	4.75:	5.95:	3.20:	.50:	.54
7	:	.45:	.60:	:	:	:	:	.80:	4.47:	7.12:	1.61:	.86:	1.83
8	:	.38:	.32:	:	:	:	:	:	:	:	.52:	:	:
	:	:	:	:	:	:	:	:	:	:	:	:	:
AVER:	:	.45:	.90:	2.21:	2.70:	7.19:	1.65:	6.18:	5.25:	6.85:	3.04:	.97:	1.05

YEAR 1904

1	:	.42:	1.10:	1.51:	1.69:	4.60:	7.15:	2.21:	4.43:	4.25:	4.76:	.03:	1.83
2	:	.67:	.50:	2.05:	1.29:	2.30:	3.50:	2.88:	6.56:	3.18:	4.59:	.10:	2.48
3	:	.36:	.81:	1.13:	2.67:	2.60:	4.72:	3.45:	4.00:	5.60:	5.73:	.02:	1.14
4	:	.22:	1.08:	1.64:	.97:	1.09:	3.47:	3.43:	2.94:	4.09:	5.89:	.08:	1.68
5	:	1.25:	1.40:	1.14:	2.20:	6.55:	8.45:	6.15:	5.51:	6.76:	5.61:	.00:	.90
7	:	.20:	.90:	1.30:	3.05:	5.95:	5.90:	2.85:	3.90:	5.75:	8.00:	.40:	2.90
	:	:	:	:	:	:	:	:	:	:	:	:	:
AVER:	:	.52:	.96:	1.46:	1.98:	3.85:	5.54:	3.49:	4.56:	4.97:	5.76:	.21:	1.82

1. The first part of the paper discusses the importance of maintaining accurate records of all transactions. It emphasizes that proper record-keeping is essential for the integrity of the financial system and for the ability to detect and prevent fraud. The text also mentions the need for transparency and accountability in all financial dealings.

2. The second part of the paper focuses on the role of the auditor in ensuring the accuracy of financial statements. It describes the various procedures and techniques used by auditors to verify the information provided by management. The text also discusses the importance of the auditor's independence and objectivity in performing their duties.

3. The third part of the paper addresses the challenges faced by companies in maintaining accurate financial records. It identifies common areas of weakness, such as inadequate internal controls and poor documentation practices. The text also provides suggestions for how companies can improve their financial reporting processes and ensure compliance with relevant regulations.

4. The final part of the paper concludes by summarizing the key points discussed and reiterating the importance of accurate financial reporting for the success of any organization. It also mentions the need for ongoing monitoring and improvement of financial reporting practices to ensure the highest level of accuracy and reliability.

YEAR 1905

STAS: JAN.: FEB.: MAR.: APR.: MAY : JUNE: JULY: AUG.: SEPT: OCT.: NOV.: DEC.

1	:	.50:	.20:	1.75:	1.20:	5.35:	16.2:	6.50:	5.60:	3.92:	1.35:	.65:	.50
2	:	1.63:	.44:	.98:	.33:	4.47:	10.4:	4.88:	6.34:	4.44:	3.45:	2.66:	2.05
3	:	.57:	.37:	1.10:	2.14:	2.68:	6.66:	4.91:	3.54:	3.93:	3.07:	2.80:	.30
4	:	1.34:	.45:	.77:	1.98:	3.13:	8.10:	2.47:	3.48:	6.58:	3.42:	1.80:	.11
5	:	1.50:	.50:	.47:	1.00:	4.50:	13.7:	3.50:	8.50:	3.70:	2.40:	2.70:	.00
7	:	1.00:	.52:	.28:	.85:	4.17:	9.2:	3.94:	6.59:	4.48:	2.39:	1.57:	1.42
8	:	:	:	:	:	4.56:	:	:	:	:	:	:	:
AVER	:	1.09:	.50:	.86:	1.25:	4.12:	10.7:	4.37:	5.67:	4.51:	2.70:	2.03:	1.00

YEAR 1906

1	:	1.80:	.20:	.50:	1.67:	5.40:	4.71:	3.90:	3.55:	2.85:	3.56:	1.90:	1.20
2	:	3.38:	.42:	1.92:	2.26:	4.11:	4.08:	.79:	3.41:	3.85:	4.39:	3.37:	1.05
3	:	2.00:	.27:	2.19:	1.15:	4.33:	5.42:	1.53:	4.73:	3.45:	3.51:	2.57:	1.35
4	:	1.37:	.37:	.90:	2.12:	3.59:	4.43:	2.38:	5.30:	5.04:	3.03:	2.90:	1.71
5	:	3.20:	.40:	1.00:	2.58:	7.45:	3.84:	3.40:	2.90:	2.98:	1.20:	.43:	1.00
7	:	4.35:	.30:	1.10:	1.41:	3.51:	4.45:	3.41:	4.68:	3.50:	3.74:	1.76:	1.53
9	:	:	:	:	:	:	:	:	:	:	1.14:	1.88:	:
AVER	:	2.68:	.33:	1.27:	1.86:	4.73:	4.49:	2.40:	4.05:	3.46:	3.43:	2.47:	1.38

YEAR 1907

1	:	.70:	.20:	.60:	.50:	2.60:	3.10:	1.50:	3.45:	5.10:	.90:	.80:	.30
2	:	1.80:	.70:	1.52:	1.06:	2.14:	1.89:	:	:	8.91:	1.16:	.68:	.48
3	:	1.33:	.75:	1.38:	.66:	2.14:	1.80:	2.52:	2.28:	8.50:	.47:	.75:	.47
4	:	1.12:	.73:	1.55:	1.94:	3.57:	1.54:	4.10:	3.47:	2.99:	.52:	.49:	.30
5	:	1.30:	1.05:	1.08:	.70:	1.83:	3.39:	2.75:	2.50:	3.75:	:	:	:
7	:	1.46:	.27:	1.89:	1.65:	3.08:	1.96:	2.08:	2.05:	4.82:	1.17:	1.09:	.33
9	:	1.05:	1.64:	2.31:	.79:	2.30:	2.27:	4.10:	2.24:	5.72:	1.10:	.90:	.65
AVER	:	1.25:	.76:	1.49:	1.05:	2.52:	2.28:	2.84:	2.81:	5.68:	.52:	.74:	.42

YEAR 1908

1	:	.70:	1.85:	1.10:	2.80:	5.08:	4.19:	4.30:	2.63:	3.60:	3.07:	2.14:	1.45
3	:	.67:	.82:	2.22:	2.64:	3.59:	5.85:	4.50:	1.50:	2.10:	2.88:	1.85:	.89
4	:	1.39:	1.42:	1.78:	2.67:	6.54:	2.48:	4.91:	1.19:	1.86:	2.42:	1.35:	.59
5	:	.50:	1.00:	1.75:	4.05:	3.85:	5.64:	2.56:	1.61:	1.46:	3.08:	.95:	.87
7	:	.72:	.86:	2.02:	2.79:	4.23:	5.00:	3.51:	2.47:	2.40:	1.39:	.88:	.70
9	:	.73:	1.26:	1.52:	3.27:	6.12:	4.61:	:	1.35:	1.94:	2.85:	1.04:	1.15
AVER	:	.78:	1.20:	1.73:	3.04:	4.90:	4.63:	3.30:	1.79:	2.23:	2.61:	1.37:	.94

1. The first part of the paper discusses the importance of maintaining accurate records of all transactions. It emphasizes that proper record-keeping is essential for the success of any business and for the protection of the interests of all parties involved.

2. The second part of the paper discusses the importance of maintaining accurate records of all transactions. It emphasizes that proper record-keeping is essential for the success of any business and for the protection of the interests of all parties involved.

3. The third part of the paper discusses the importance of maintaining accurate records of all transactions. It emphasizes that proper record-keeping is essential for the success of any business and for the protection of the interests of all parties involved.

4. The fourth part of the paper discusses the importance of maintaining accurate records of all transactions. It emphasizes that proper record-keeping is essential for the success of any business and for the protection of the interests of all parties involved.

YEAR 1909

28.

STAS: JAN.: FEB.: MAR.: APR.: MAY : JUNE: JULY: AUG.: SEPT: OCT.: NOV.: DEC.

1	:	.05	:	1.50	:	.90	:	2.55	:	1.90	:	3.72	:	3.37	:	2.15	:	3.54	:	2.05	:	5.10	:	1.15
2	:	.43	:		:		:		:		:	3.70	:		:		:	3.09	:		:		:	.62
3	:	.40	:	1.52	:	.59	:	3.02	:	2.92	:	2.75	:	3.55	:	3.83	:	2.25	:	3.87	:	4.42	:	.58
4	:	.56	:	2.10	:	1.00	:	2.55	:	4.38	:	3.04	:	8.70	:	4.14	:	2.93	:	1.83	:	2.47	:	.94
5	:	.35	:	1.35	:	.80	:	3.61	:	2.60	:	2.56	:	2.96	:	4.08	:	4.27	:	2.54	:	4.18	:	1.24
7	:	.85	:	1.43	:	1.37	:	3.20	:	3.00	:	.86	:	3.60	:	1.90	:	2.51	:	2.45	:	4.52	:	.94
9	:	1.01	:	1.62	:	1.67	:	3.78	:	4.78	:	3.08	:	4.23	:	2.80	:	2.23	:	1.14	:	4.06	:	1.87
AVER	:	.52	:	1.59	:	1.05	:	3.12	:	3.26	:	2.67	:	4.30	:	3.15	:	2.95	:	2.42	:	4.17	:	1.06

YEAR 1910

1	:	1.05	:	.20	:	.10	:	4.45	:	3.85	:	.92	:	2.51	:	5.18	:	2.00	:	2.10	:	.60	:	.80
3	:	.75	:	.90	:	.35	:	1.10	:	3.20	:	1.04	:	3.12	:	2.49	:	2.08	:	.80	:	.50	:	1.00
4	:	.96	:	1.01	:	0.00	:	1.78	:	2.76	:	.51	:	3.95	:	1.78	:	3.39	:	1.09	:	0.00	:	.82
5	:	1.19	:	.55	:	0.00	:	.90	:	2.17	:	.74	:	2.21	:	1.80	:	2.07	:	1.54	:	1.40	:	.75
7	:	.96	:	.77	:	.42	:	1.87	:	2.77	:	.51	:	3.29	:	3.03	:	2.21	:	1.32	:	1.54	:	
9	:	.97	:	.78	:	.18	:	1.14	:	2.81	:	1.91	:	3.83	:	2.44	:	2.69	:	1.26	:	1.03	:	.95
AVER	:	.98	:	.72	:	.17	:	1.87	:	2.93	:	.94	:	3.15	:	2.80	:	2.51	:	1.33	:	.85	:	.86

YEAR 1911

1	:	.95	:	1.10	:	1.20	:	.75	:	5.60	:	3.25	:	6.48	:	2.84	:	7.32	:	8.80	:	2.60	:	2.85
3	:	.96	:	1.10	:	1.55	:	.73	:	2.93	:	2.49	:	6.09	:	3.01	:	5.43	:	3.70	:	1.60	:	1.55
4	:	1.00	:	1.93	:	1.07	:	.54	:	4.79	:	1.77	:	6.07	:	2.45	:	3.79	:	2.34	:	1.66	:	1.48
5	:	.86	:	.75	:	.88	:	1.27	:	3.68	:	4.37	:	3.90	:	2.79	:	6.75	:	7.26	:	1.39	:	2.13
7	:		:	.75	:	1.57	:	2.02	:	4.53	:	2.07	:	4.69	:	1.71	:	4.47	:	6.87	:	2.27	:	2.34
9	:	.59	:	.81	:	1.43	:	1.12	:	3.85	:	2.64	:	4.58	:	2.13	:	7.04	:	7.08	:	2.22	:	2.30
AVER	:	.87	:	1.07	:	1.28	:	1.07	:	4.23	:	2.76	:	5.30	:	2.49	:	5.80	:	6.01	:	1.96	:	2.11

cYEAR 1912

1	:	.30	:	.10	:	.40	:	3.88	:	6.62	:	.12	:	7.45	:	7.69	:	4.75	:	1.80	:	.55	:	2.55
3	:	.65	:	.45	:	.45	:	2.18	:	4.81	:	2.28	:	2.53	:	6.10	:	2.35	:		:	.22	:	1.44
4	:	.36	:	.10	:	.17	:	2.64	:	5.34	:	2.27	:	2.13	:	4.76	:	1.00	:	1.14	:	.71	:	1.54
5	:	.40	:	.25	:	.35	:	2.90	:	6.98	:	1.28	:	5.13	:	8.57	:	3.39	:	2.59	:	.10	:	1.83
7	:	.37	:	.03	:	.40	:	3.37	:	8.59	:	1.44	:	7.02	:	7.20	:	3.91	:	2.16	:	.44	:	1.44
9	:	.74	:	.25	:	.62	:	2.67	:	7.01	:	1.27	:	4.50	:	8.27	:	3.56	:	2.21	:	.22	:	1.42
AVER	:	.47	:	.20	:	.40	:	2.96	:	6.56	:	1.44	:	5.29	:	7.10	:	3.33	:	1.98	:	.37	:	1.70

[illegible][illegible]

APPENDIX "B"DAILY CUMULATIVE RAINFALL FOR THE YEAR
1904

DATE	DAILY PREC'N.	CUMULATIVE PREC'N.	:	DATE	DAILY PREC'N.	CUMULATIVE PREC'N.
JAN. 1,	0.0"	0.0"	:	FEB. 1,	.05"	.50"
2,	.00	.00	:	2,	.06	.56
3,	.00	.00	:	3,	.00	.56
4,	.00	.00	:	4,	.00	.56
5,	.01	.01	:	5,	.00	.56
6,	.00	.01	:	6,	.01	.57
7,	.02	.03	:	7,	.03	.60
8,	.00	.03	:	8,	.00	.60
9,	.00	.03	:	9,	.00	.60
10,	.00	.03	:	10,	.00	.60
11,	.02	.05	:	11,	.00	.60
12,	.04	.09	:	12,	.06	.66
13,	.00	.09	:	13,	.21	.87
14,	.00	.09	:	14,	.00	.87
15,	.00	.09	:	15,	.00	.87
16,	.00	.09	:	16,	.00	.87
17,	.00	.09	:	17,	.06	.93
18,	.01	.10	:	18,	.07	1.00
19,	.00	.10	:	19,	.00	1.00
20,	.00	.10	:	20,	.00	1.00
21,	.31	.41	:	21,	.03	1.03
22,	.03	.44	:	22,	.02	1.05
23,	.00	.44	:	23,	.15	1.20
24,	.00	.44	:	24,	.02	1.22
25,	.00	.44	:	25,	.00	1.22
26,	.00	.44	:	26,	.05	1.27
27,	.00	.44	:	27,	.01	1.28
28,	.00	.44	:	28,	.04	1.32
29,	.00	.44	:	29,	.07	1.39
30,	.00	.44	:			
31,	.01	.45	:			

DAILY CUMULATIVE RAINFALL FOR THE YEAR 1904 (Cont.)

DATE	DAILY PREC'N.	CUMULATIVE PREC'N.	:	DATE	DAILY PREC'N.	CUMULATIVE PREC'N.
MAR. 1,	.00"	1.39"	:	APRIL 1,	.04"	2.73"
2,	.34	1.73	:	2,	.03	2.76
3,	.03	1.76	:	3,	.00	2.76
4,	.00	1.76	:	4,	.00	2.76
5,	.00	1.76	:	5,	.12	2.88
6,	.00	1.76	:	6,	.00	2.88
7,	.00	1.76	:	7,	.00	2.88
8,	.00	1.76	:	8,	.16	3.04
9,	.02	1.78	:	9,	.14	3.18
10,	.08	1.86	:	10,	.00	3.18
11,	.01	1.87	:	11,	.18	3.36
12,	.00	1.87	:	12,	.00	3.36
13,	.01	1.88	:	13,	.01	3.37
14,	.22	2.10	:	14,	.19	3.56
15,	.00	2.10	:	15,	.49	4.05
16,	.00	2.10	:	16,	.11	4.16
17,	.00	2.10	:	17,	.00	4.16
18,	.00	2.10	:	18,	.00	4.16
19,	.18	2.28	:	19,	.00	4.16
20,	.00	2.28	:	20,	.00	4.16
21,	.11	2.39	:	21,	.00	4.16
22,	.00	2.39	:	22,	.12	4.28
23,	.00	2.39	:	23,	.00	4.28
24,	.18	2.57	:	24,	.00	4.28
25,	.02	2.59	:	25,	.00	4.28
26,	.00	2.59	:	26,	.00	4.28
27,	.00	2.59	:	27,	.00	4.28
28,	.00	2.59	:	28,	.00	4.28
29,	.01	2.60	:	29,	.00	4.28
30,	.00	2.60	:	30,	.00	4.28
31,	.09	2.69	:			

DAILY CUMULATIVE RAINFALL FOR THE YEAR 1904 (Cont.)

DATE	DAILY PREC'N.	CUMULATIVE PREC'N.	:	DATE	DAILY PREC'N.	CUMULATIVE PREC'N.
MAY 1,	.00 "	4.28 "	:	JUNE 1,	.00 "	7.13 "
2,	.00	4.28	:	2,	.20	7.33
3,	.00	4.28	:	3,	.63	7.96
4,	.00	4.28	:	4,	1.50	9.46
5,	.06	4.34	:	5,	.30	9.76
6,	.02	4.36	:	6,	.08	9.84
7,	.19	4.55	:	7,	.02	9.86
8,	.31	4.86	:	8,	.00	9.86
9,	.00	4.86	:	9,	.00	9.86
10,	.00	4.86	:	10,	.00	9.86
11,	.02	4.88	:	11,	.00	9.86
12,	.01	4.89	:	12,	.06	9.92
13,	.26	5.15	:	13,	.00	9.92
14,	.00	5.15	:	14,	.03	9.95
15,	.00	5.15	:	15,	.00	9.95
16,	.00	5.15	:	16,	.00	9.95
17,	.00	5.15	:	17,	.02	9.97
18,	.03	5.18	:	18,	.04	10.01
19,	.00	5.18	:	19,	.04	10.05
20,	.27	5.45	:	20,	.02	10.07
21,	.08	5.53	:	21,	.01	10.08
22,	.14	5.67	:	22,	.14	10.22
23,	.23	5.90	:	23,	.90	11.12
24,	.72	6.62	:	24,	.00	11.12
25,	.33	6.95	:	25,	.40	11.52
26,	.17	7.12	:	26,	.20	11.72
27,	.00	7.12	:	27,	.00	11.72
28,	.00	7.12	:	28,	.26	11.98
29,	.01	7.13	:	29,	.34	12.32
30,	.00	7.13	:	30,	.33	12.65
31,	.00	7.13	:			

DAILY CUMULATIVE RAINFALL FOR THE YEAR 1904 (Cont.)

DATE	DAILY PREC'N.	CUMULATIVE PREC'N.	:	DATE	DAILY PREC'N.	CUMULATIVE PREC'N.
JULY 1,	.00	12.65	:	AUGUST 1,	.01	16.02
2,	.00	12.65	:	2,	.00	16.02
3,	.78	13.43	:	3,	.02	16.04
4,	.27	13.70	:	4,	.07	16.11
5,	.00	13.70	:	5,	.00	16.11
6,	.00	13.70	:	6,	.24	16.35
7,	.00	13.70	:	7,	.31	16.66
8,	.41	14.11	:	8,	.12	16.78
9,	.18	14.29	:	9,	.91	17.69
10,	.14	14.43	:	10,	.00	17.69
11,	.02	14.45	:	11,	.00	17.69
12,	.00	14.45	:	12,	.47	18.16
13,	.25	14.70	:	13,	.00	18.16
14,	.22	14.92	:	14,	.00	18.16
15,	.00	14.92	:	15,	.00	18.16
16,	.00	14.92	:	16,	.04	18.20
17,	.05	14.97	:	17,	.00	18.20
18,	.14	15.11	:	18,	.00	18.20
19,	.00	15.11	:	19,	.25	18.45
20,	.03	15.14	:	20,	.27	18.72
21,	.02	15.16	:	21,	1.32	20.04
22,	.06	15.22	:	22,	.00	20.04
23,	.00	15.22	:	23,	.00	20.04
24,	.00	15.22	:	24,	.09	20.13
25,	.17	15.39	:	25,	.00	20.13
26,	.13	15.52	:	26,	.00	20.13
27,	.01	15.53	:	27,	.00	20.13
28,	.00	15.53	:	28,	.23	20.36
29,	.28	15.81	:	29,	.04	20.40
30,	.20	16.01	:	30,	.01	20.41
31,	.00	16.01	:	31,	.15	20.56

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180	181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210	211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260	261	262	263	264	265	266	267	268	269	270	271	272	273	274	275	276	277	278	279	280	281	282	283	284	285	286	287	288	289	290	291	292	293	294	295	296	297	298	299	300	301	302	303	304	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319	320	321	322	323	324	325	326	327	328	329	330	331	332	333	334	335	336	337	338	339	340	341	342	343	344	345	346	347	348	349	350	351	352	353	354	355	356	357	358	359	360	361	362	363	364	365	366	367	368	369	370	371	372	373	374	375	376	377	378	379	380	381	382	383	384	385	386	387	388	389	390	391	392	393	394	395	396	397	398	399	400	401	402	403	404	405	406	407	408	409	410	411	412	413	414	415	416	417	418	419	420	421	422	423	424	425	426	427	428	429	430	431	432	433	434	435	436	437	438	439	440	441	442	443	444	445	446	447	448	449	450	451	452	453	454	455	456	457	458	459	460	461	462	463	464	465	466	467	468	469	470	471	472	473	474	475	476	477	478	479	480	481	482	483	484	485	486	487	488	489	490	491	492	493	494	495	496	497	498	499	500	501	502	503	504	505	506	507	508	509	510	511	512	513	514	515	516	517	518	519	520	521	522	523	524	525	526	527	528	529	530	531	532	533	534	535	536	537	538	539	540	541	542	543	544	545	546	547	548	549	550	551	552	553	554	555	556	557	558	559	560	561	562	563	564	565	566	567	568	569	570	571	572	573	574	575	576	577	578	579	580	581	582	583	584	585	586	587	588	589	590	591	592	593	594	595	596	597	598	599	600	601	602	603	604	605	606	607	608	609	610	611	612	613	614	615	616	617	618	619	620	621	622	623	624	625	626	627	628	629	630	631	632	633	634	635	636	637	638	639	640	641	642	643	644	645	646	647	648	649	650	651	652	653	654	655	656	657	658	659	660	661	662	663	664	665	666	667	668	669	670	671	672	673	674	675	676	677	678	679	680	681	682	683	684	685	686	687	688	689	690	691	692	693	694	695	696	697	698	699	700	701	702	703	704	705	706	707	708	709	710	711	712	713	714	715	716	717	718	719	720	721	722	723	724	725	726	727	728	729	730	731	732	733	734	735	736	737	738	739	740	741	742	743	744	745	746	747	748	749	750	751	752	753	754	755	756	757	758	759	760	761	762	763	764	765	766	767	768	769	770	771	772	773	774	775	776	777	778	779	780	781	782	783	784	785	786	787	788	789	790	791	792	793	794	795	796	797	798	799	800	801	802	803	804	805	806	807	808	809	810	811	812	813	814	815	816	817	818	819	820	821	822	823	824	825	826	827	828	829	830	831	832	833	834	835	836	837	838	839	840	841	842	843	844	845	846	847	848	849	850	851	852	853	854	855	856	857	858	859	860	861	862	863	864	865	866	867	868	869	870	871	872	873	874	875	876	877	878	879	880	881	882	883	884	885	886	887	888	889	890	891	892	893	894	895	896	897	898	899	900	901	902	903	904	905	906	907	908	909	910	911	912	913	914	915	916	917	918	919	920	921	922	923	924	925	926	927	928	929	930	931	932	933	934	935	936	937	938	939	940	941	942	943	944	945	946	947	948	949	950	951	952	953	954	955	956	957	958	959	960	961	962	963	964	965	966	967	968	969	970	971	972	973	974	975	976	977	978	979	980	981	982	983	984	985	986	987	988	989	990	991	992	993	994	995	996	997	998	999	1000	1001	1002	1003	1004	1005	1006	1007	1008	1009	1010	1011	1012	1013	1014	1015	1016	1017	1018	1019	1020	1021	1022	1023	1024	1025	1026	1027	1028	1029	1030	1031	1032	1033	1034	1035	1036	1037	1038	1039	1040	1041	1042	1043	1044	1045	1046	1047	1048	1049	1050	1051	1052	1053	1054	1055	1056	1057	1058	1059	1060	1061	1062	1063	1064	1065	1066	1067	1068	1069	1070	1071	1072	1073	1074	1075	1076	1077	1078	1079	1080	1081	1082	1083	1084	1085	1086	1087	1088	1089	1090	1091	1092	1093	1094	1095	1096	1097	1098	1099	1100	1101	1102	1103	1104	1105	1106	1107	1108	1109	1110	1111	1112	1113	1114	1115	1116	1117	1118	1119	1120	1121	1122	1123	1124	1125	1126	1127	1128	1129	1130	1131	1132	1133	1134	1135	1136	1137	1138	1139	1140	1141	1142	1143	1144	1145	1146	1147	1148	1149	1150	1151	1152	1153	1154	1155	1156	1157	1158	1159	1160	1161	1162	1163	1164	1165	1166	1167	1168	1169	1170	1171	1172	1173	1174	1175	1176	1177	1178	1179	1180	1181	1182	1183	1184	1185	1186	1187	1188	1189	1190	1191	1192	1193	1194	1195	1196	1197	1198	1199	1200	1201	1202	1203	1204	1205	1206	1207	1208	1209	1210	1211	1212	1213	1214	1215	1216	1217	1218	1219	1220	1221	12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DAILY CUMULATIVE RAINFALL FOR THE YEAR 1904 (Cont.)

DATE	DAILY PREC'N.	CUMULATIVE : PREC'N. :	DATE	DAILY PREC'N.	CUMULATIVE PREC'N.
SEPT. 1,	1.25"	21.81"	OCT. 1,	.01"	25.20"
2,	.89	22.70	2,	.00	25.20
3,	.07	22.77	3,	.10	25.30
4,	.00	22.77	4,	.27	25.57
5,	.00	22.77	5,	.00	25.57
6,	.04	22.81	6,	.00	25.57
7,	.00	22.81	7,	.80	26.37
8,	.07	22.88	8,	.49	26.86
9,	.00	22.88	9,	1.74	28.60
10,	.00	22.88	10,	.19	28.79
11,	.00	22.88	11,	.02	28.81
12,	.00	22.88	12,	.02	28.83
13,	.27	23.15	13,	.00	28.83
14,	.03	23.18	14,	.00	28.83
15,	.00	23.18	15,	.00	28.83
16,	.00	23.18	16,	.00	28.83
17,	.00	23.18	17,	.00	28.83
18,	.00	23.18	18,	.18	29.01
19,	.02	23.20	19,	.52	29.53
20,	.00	23.20	20,	.95	30.48
21,	.00	23.20	21,	.11	30.59
22,	.00	23.20	22,	.01	30.60
23,	.52	23.72	23,	.00	30.60
24,	.78	24.50	24,	.07	30.67
25,	.06	24.56	25,	.06	30.73
26,	.00	24.56	26,	.05	30.78
27,	.04	24.60	27,	.00	30.78
28,	.59	25.19	28,	.00	30.78
29,	.00	25.19	29,	.00	30.78
30,	.00	25.19	30,	.00	30.78
			31,	.00	30.78

DAILY CUMULATIVE RAINFALL FOR THE YEAR 1904 (Cont.)

DATE	DAILY PREC'N.	CUMULATIVE PREC'N.	:	DATE	DAILY PREC'N.	CUMULATIVE PREC'N.
NOV. 1,	.00"	30.78"	:	DEC. 1,	.00"	30.95"
2,	.00	30.78	:	2,	.00	30.95
3,	.00	30.78	:	3,	.04	30.99
4,	.00	30.78	:	4,	.00	30.99
5,	.00	30.78	:	5,	.00	30.99
6,	.00	30.78	:	6,	.00	30.99
7,	.00	30.78	:	7,	.00	30.99
8,	.00	30.78	:	8,	.01	31.00
9,	.00	30.78	:	9,	.05	31.05
10,	.03	30.81	:	10,	.06	31.11
11,	.00	30.81	:	11,	.16	31.27
12,	.00	30.81	:	12,	.11	31.38
13,	.00	30.81	:	13,	.00	31.38
14,	.00	30.81	:	14,	.00	31.38
15,	.00	30.81	:	15,	.00	31.38
16,	.00	30.81	:	16,	.00	31.38
17,	.00	30.81	:	17,	.00	31.38
18,	.00	30.81	:	18,	.08	31.46
19,	.00	30.81	:	19,	.09	31.55
20,	.00	30.81	:	20,	.10	31.65
21,	.07	30.88	:	21,	.05	31.70
22,	.00	30.88	:	22,	.01	31.73
23,	.00	30.88	:	23,	.02	31.75
24,	.00	30.88	:	24,	.00	31.75
25,	.00	30.88	:	25,	.00	31.75
26,	.01	30.89	:	26,	.21	31.96
27,	.00	30.89	:	27,	.12	32.08
28,	.01	30.90	:	28,	.70	32.78
29,	.05	30.95	:	29,	.00	32.78
30,	.00	30.95	:	30,	.00	32.78
			:	31,	.00	32.78

APPENDIX "C"FLOOD FLOW DATAYear 1903

RIVER	MAX. DISCHARGE IN SEC. FEET	DRAINAGE AREA SQUARE MILES	FLOW - SEC. FT./SQ.MILE
Chippewa	51,750	6,740	7.7
Flambeau	10,800	2,120	5.1
Black	12,500	2,050	6.1
Wisconsin	13,000	3,100	4.2
Wolf	4,500	3,800	1.2
Menominee	10,500	1,800	6.3

Year 1904

Chippewa	33,000	6,740	4.9
Flambeau	7,500	2,120	3.5
Wisconsin	18,000	3,100	5.8
Menominee	11,700	1,800	6.5

Year 1905

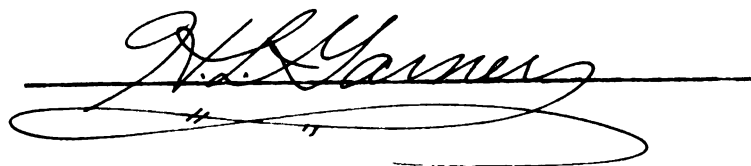
Chippewa	23,000	6,740	3.4
Flambeau	8,400	2,120	4.0
Black	14,000	800	17.5
Wisconsin	13,500	3,100	4.4
Wolf	6,900	2,400	2.9
Menominee	9,500	1,800	5.3

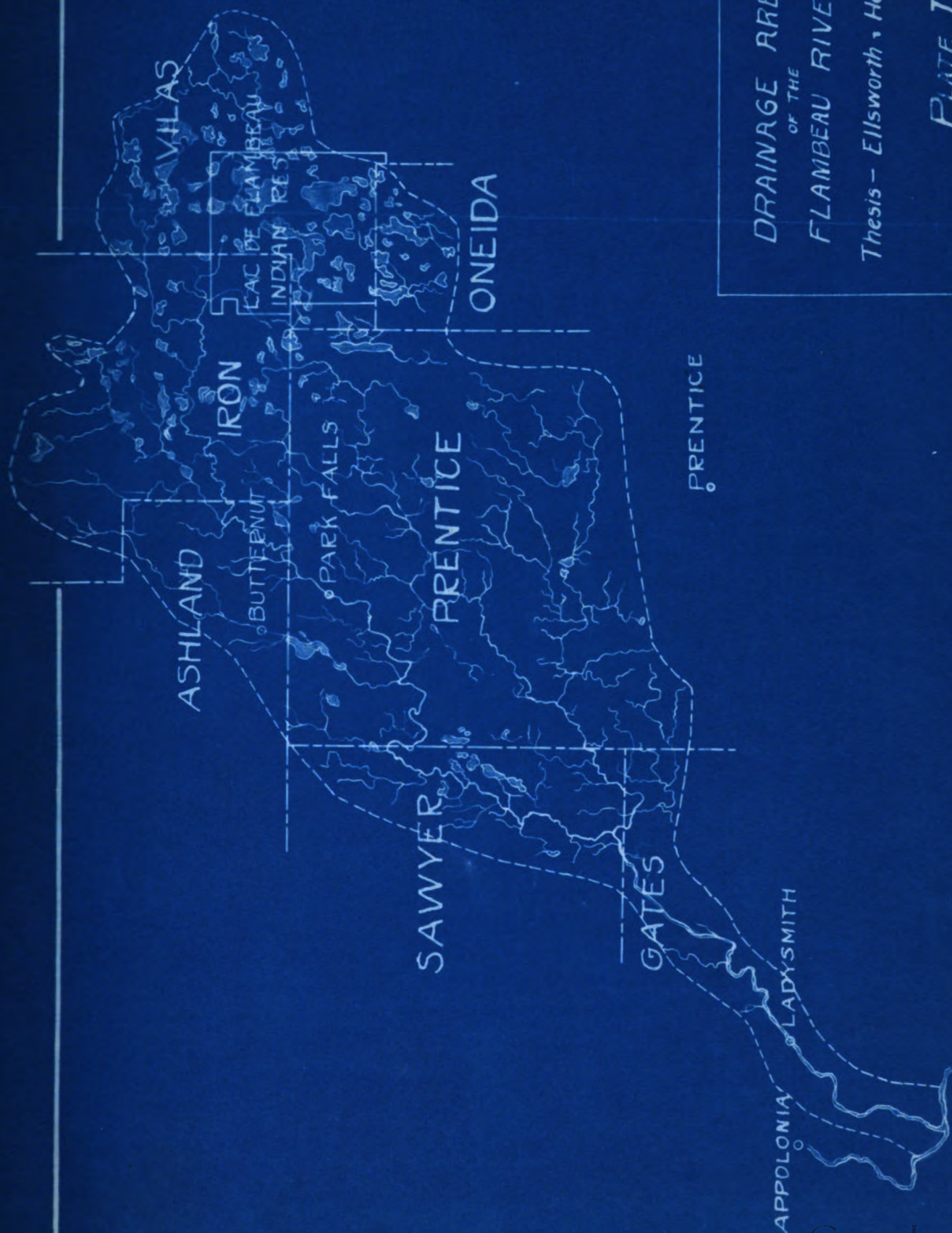
FLOOD FLOW DATA - (Cont)

36.

<u>Year 1906</u>			
RIVER	MAX. DISCHARGE IN SEC. FEET	DRAINAGE AREA SQUARE MILES	FLOW - SEC. FT./ SQ. MI.
Chippewa	38,000	6,740	5.6
Flambeau	11,000	2,120	5.2
Black	5,000	800	6.3
Wisconsin	16,000	3,100	5.2
Menominee	14,000	1,800	7.7
<u>Year 1907</u>			
Chippewa	39,000	6,740	5.8
Black	8,700	800	10.9
Wisconsin	12,000	3,100	3.9
Wolf	2,500	970	2.6
Menominee	15,000	1,800	8.3
<u>Year 1908</u>			
Chippewa	30,000	6,740	4.5
Black	7,000	800	8.8
Wisconsin	13,500	3,100	4.3
Wolf	3,000	970	3.1
Menominee	12,000	1,800	6.7
<u>Year 1909</u>			
Chippewa	27,000	6,620	4.1
Wisconsin	12,000	3,100	3.9
Menominee	5,700	1,800	3.2

APPROVED:

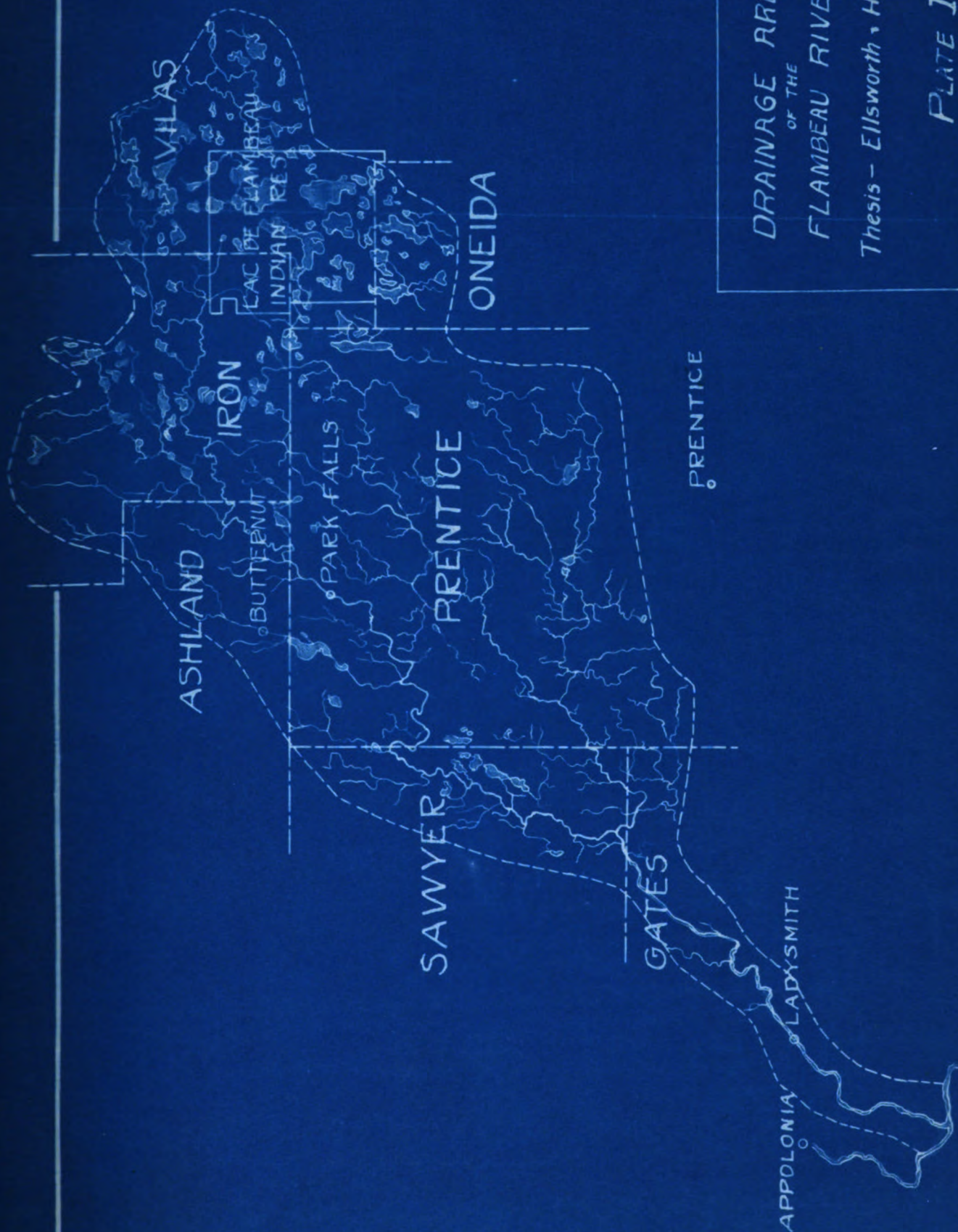
A handwritten signature in cursive script, reading "J. H. Garner", is written over a horizontal line. Below the line, there is a large, decorative flourish that loops under the signature.



DRAINAGE AREA
OF THE
FLAMBEAU RIVER

Thesis - Ellsworth & Hendricks

PLATE I



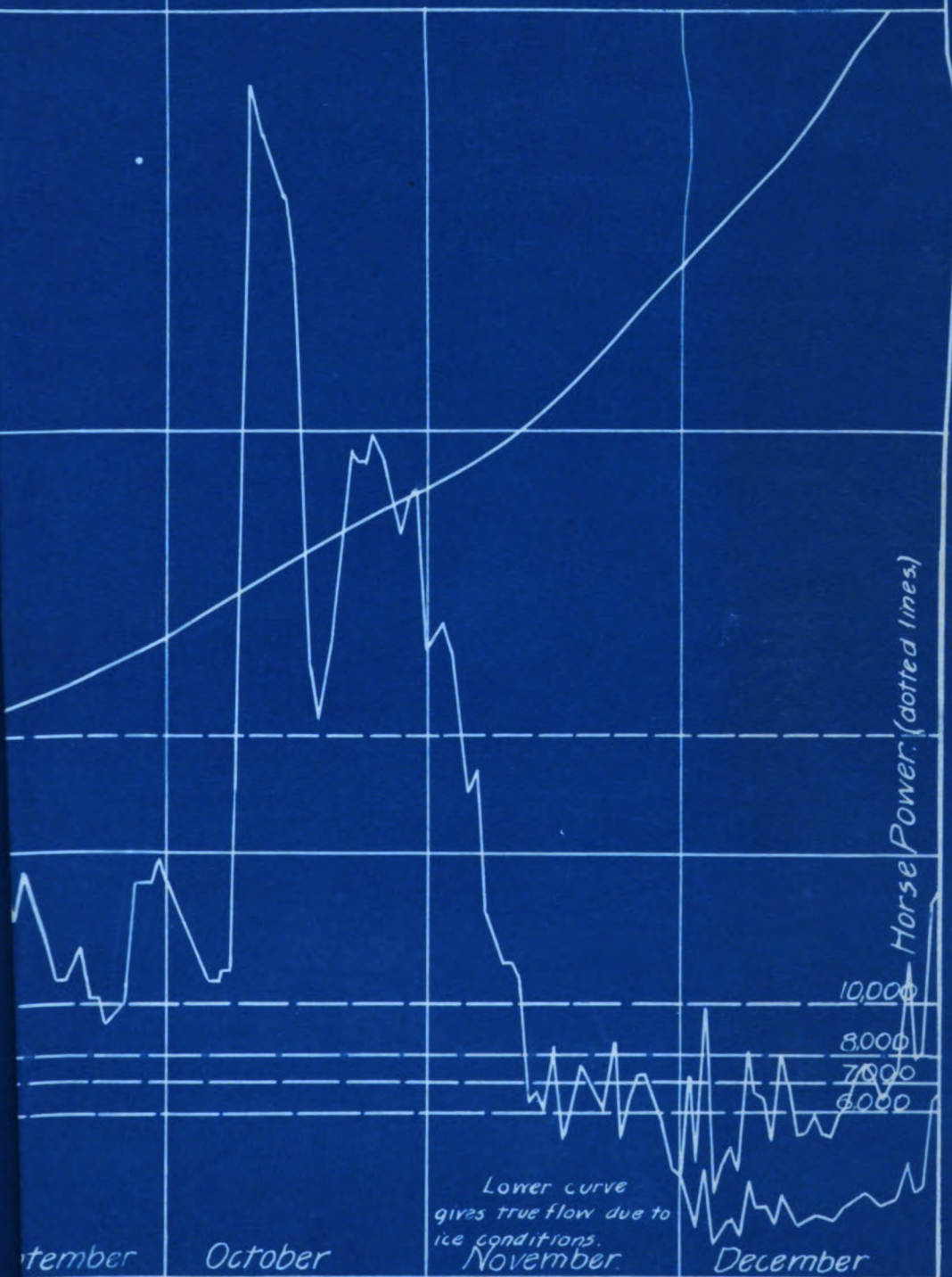
DRAINAGE AREA
OF THE
FLAMBEAU RIVER

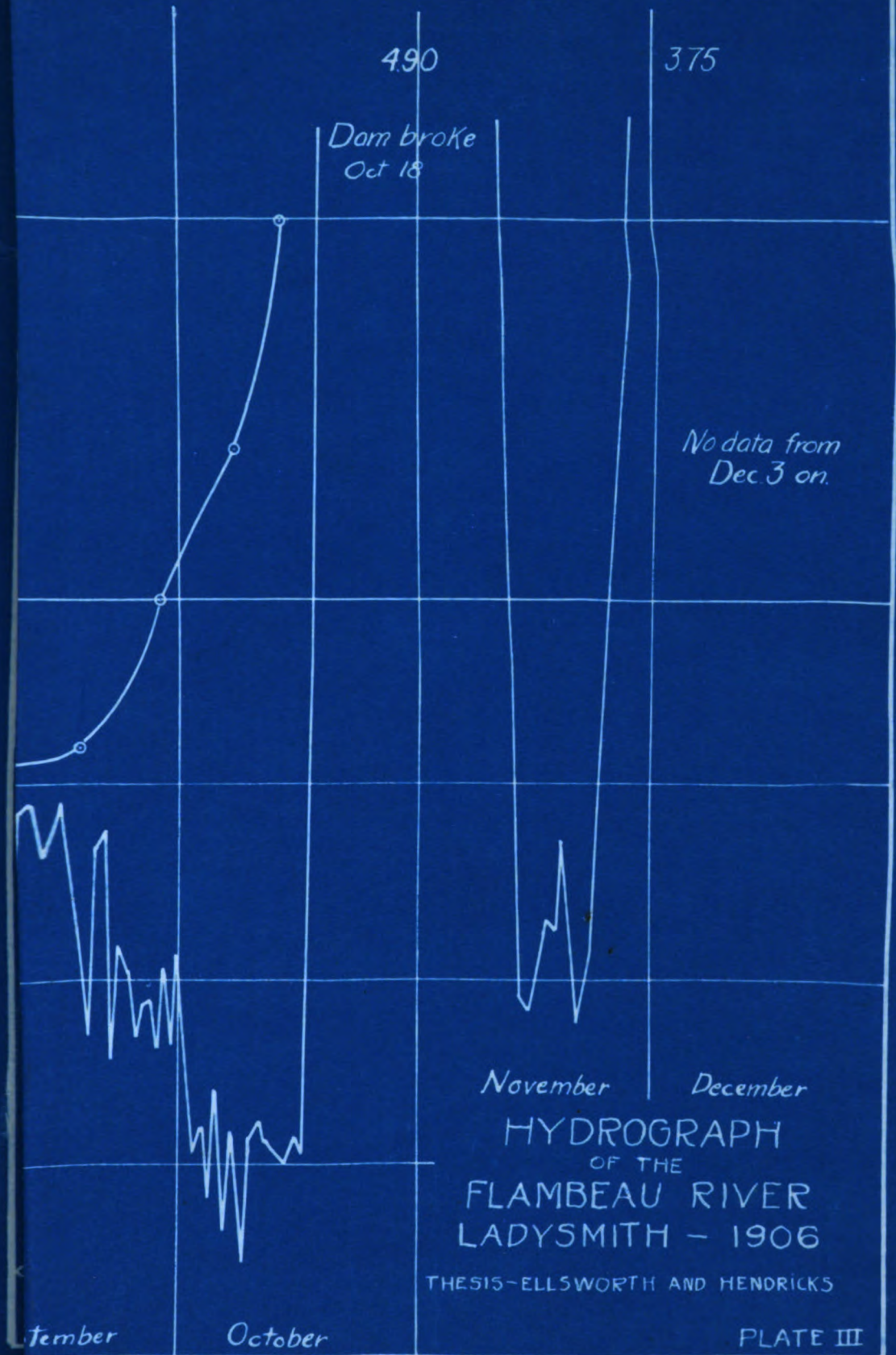
Thesis - Ellsworth & Hendricks

PLATE I

HYDROGRAPH OF THE FLAMBEAU RIVER AT LADYSMITH 1904

UNIVERSITY OF WISCONSIN.
THESIS - ELLSWORTH AND HENDRICKS
PLATE II





PLATES IV - VII

CURVES SHOWING AVERAGE MONTHLY RAINFALL

1889-1913

THE UNIVERSITY OF CHICAGO

1911-1912